Ordering number: EN 1216C

Monolithic Linear IC

No.1216C

SANYO

LA2200, 2205

ARI (Autofahrer Rundfunk Informationen) System for Car Radios - SK Type

The LA2200, 2205 have a signal detector and a signal control circuit for a traffic information system, now in effect or planned in Europe, and can make up the SK system. The LA2200, 2205 also have the BK, DK signal output pin for future system extension.

Functions

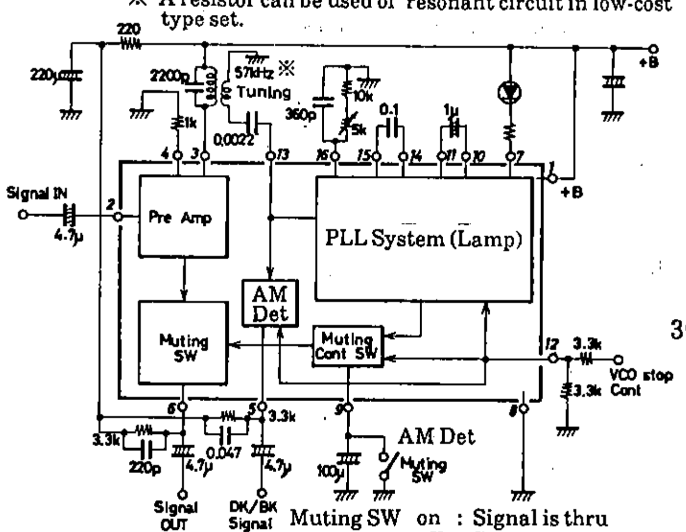
- Check of 57kHz signal (PLL)
- Indicator lamp driving
- Audio signal muting
- VCO stopping
- AM detection of 57kHz signal (BK, DK)

Operation

- SK Operation
  1) Lamp indicator LED also usable controlled by 57kHz SK signal.
  2) AF signal controlled (muting) by 57kHz SK signal.
     when 57kHz signal exists : A signal sounds.
     when 57kHz signal does not exist : A signal is muted.
  3) Stopping function 2) shown above.
     Whether 57kHz signal exists or not, AF signal sounds and only lamp turns on or off.
     In addition to these useful functions, the LA2200, 2205 have 57kHz AF detector (BK, DK signals output) for future system extension.
- Lamp Turn-on Level
  Selectable (2mV min.) depending on the ratio of the resistance of pin 3 load or resonance resistance and that of pin 4.
- Muting Operation
  When 57kHz signal does not exist at the SK operation mode, AF signal is muted (46dB typ).
  When pin 9 is grounded, signal is thru whether 57kHz signal exists or not.
- VCO Stop
  When a voltage (+6V max) is applied to frequency chek terminal (pin 12), PLL operation stops and signal is thru.
- BK, DK Output
  57kHz AM detector circuit makes output of BK and DK signals. Detecting operation stops when VCO stops.

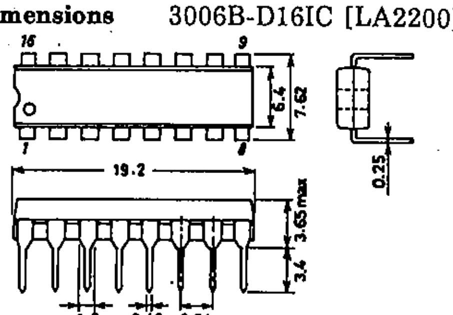
Equivalent Circuit Block Diagram

※ A resistor can be used of resonant circuit in low-cost type set.



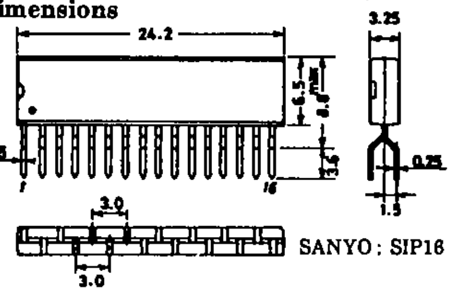
Unit (resistance: Ω, capacitance: F)

Package Dimensions 3006B-D16IC [LA2200]
(unit: mm)



SANYO: DIP16

Package Dimensions
(unit: mm)
3020A-S16IC
[LA2205]



SANYO: SIP16

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Maximum Ratings at Ta = 25°C

				unit
Maximum Supply Voltage	V_{CC} max	$V_{1\text{-}8}$	16	V
		$V_{7\text{-}8}$	16	V
		$V_{3\text{-}4}$	16	V
Lamp Driving Current	I_L		60	mA
Allowable Power Dissipation	Pd max	Ta≦70°C	490	mW
Operating Temperature	Topg		−20 to +70	°C
Storage Temperature	Tstg		−40 to +125	°C

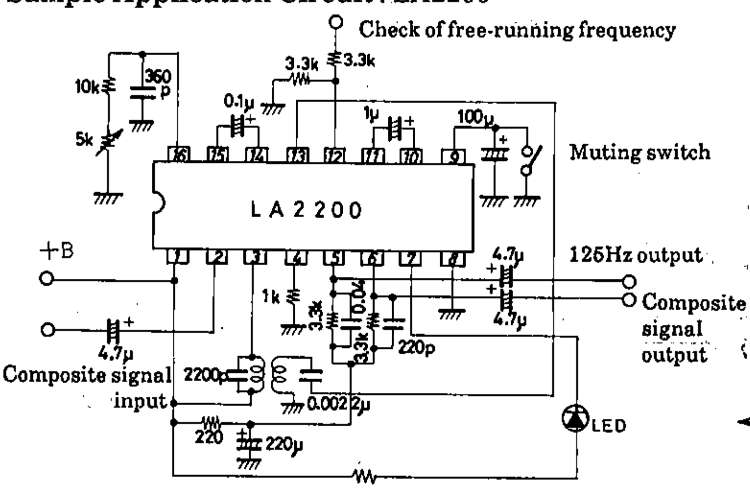
Recommended Operating Conditions at Ta = 25°C

				unit
Recommended Supply Voltage	V_{CC}		6.5 to 12.0	V
Input Signal Voltage	v_i		200 to 300	mV
	v_i57kHz		V_L + (6 to 10)	dB
Lamp Driving Current	I_L	Pin7	0 to 40	mA

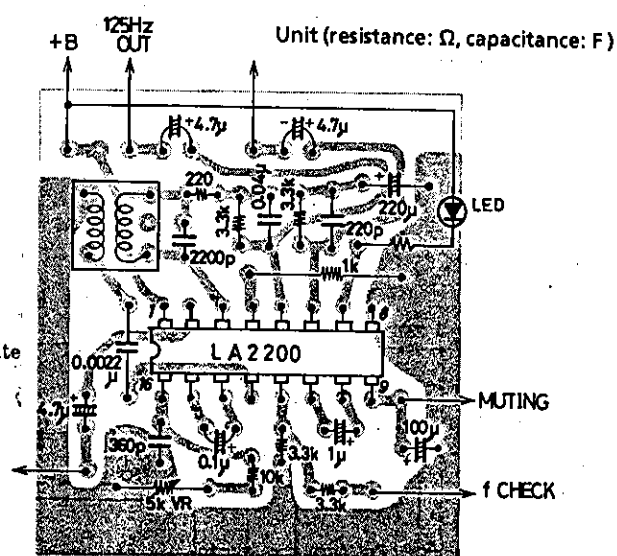
Operating Characteristics at Ta = 25°C, V_{CC} = 12V, L+R = 85%, 19kHz pilot = 10%, 57kHz pilot = 5%, f = 1kHz

			min	typ	max	unit
Quiescent Current	Icco			20	27	mA
Input Resistance	r_i			40k		Ω
Lamp Turn-on Level	V_L	f = 57kHz	3.5	5.0	7.0	mV
Hysteresis	hy	f = 57kHz			6	dB
Capture Range	C.R.	f = 57kHz, v_i = 10mV		±1.5		%
Total Harmonic Distortion	THD	v_i = 200mV, f = 1kHz		0.2	0.5	%
Output Level	v_{oAF}	v_i = 200mV, f = 1kHz	135	191	270	mV
Dynamic Range	-	v_i = 500mV, f = 1kHz			1.0	%
DK Output	v_{oDK}	v_i57kHz = 10mV, 125kHz-30%mod	6.4	9.0	12.7	mV
Signal Attenuation	-	v_i = 200mV, f = 1kHz	−40	−46		dB

Sample Application Circuit: LA2200

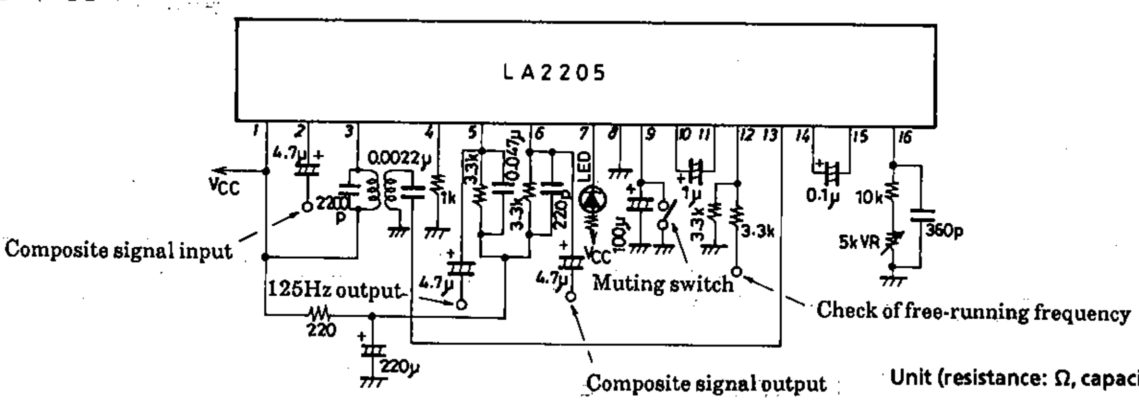


Unit (resistance: Ω, capacitance: F)



Sample Printed Circuit Pattern (37.5×35mm² Cu-foiled side)

Sample Application Circuit: LA2205



Unit (resistance: Ω, capacitance: F)

Operation of LA2200, 2205

The operation mode of the LA2200, 2205 is divided into ARI mode and other modes. These modes are controlled by the presence or absence of 57kHz signal, control terminal supply voltage and external muting switch. These are shown below :

Condition \ Modes		AM	Normal FM	ARI (FM)				Pin No.
Control state of VCO		1 (stop)	1 (stop)	0 (oper)	0 (oper)	0 (oper)	0 (oper)	12
57kHz signal		–	–	no	no	yes	yes	2
External Muting SW		–	–	off	on	off	on	9
Output Signal	AF	yes	yes	no	yes	yes	yes	6
	BK, DK	no	no	no	no	yes	yes	5
Lamp Indication		off	off	off	off	no	no	7

Notes
1 : A certain fixed voltage is applied.
0 : The voltage applied to obtain "1" level is turned off.
– : Not related to the presence or absence.
stop : Operation stops.
oper : Operates.

Priority of operation mode is as follows :

For output signal :

In the presence of AF signal, Control (pin12) > external muting switch > 57kHz signal

In the absence of BK, DK signal, Control (pin12) > 57kHz signal
Not related to external muting switch.

For lamp indication :

Lamp off Control (pin12) > 57kHz signal
Not related to external muting switch.

Description of symbol

A > B A is prior to B.

Notes on Use of LA2200, 2205

1. Voltage Characteristics
   - Fig.1 shows the current dissipation, power dissipation vs. supply voltage characteristics. Fig.2 shows the residual voltage (pin 7), power dissipation vs. lamp current characteristics.
   - Since the LA2200, 2205 have a PLL system, the power dissipation should not be increased excessively by raising V_{CC} (voltage on pin 1) to decrease VCO drift at the switch-ON mode.
   - Fig.3 shows the VCO free-running frequency drift vs. supply voltage characteristic. With 57kHz centered, 0.285kHz and 0.57kHz represent 0.5% and 1%, respectively. These values are referred to for setting a capture range mentioned below.
   - Fig.4 shows the output signal, muting attenuation vs. supply voltage characteristic. Fig.5 shows the lamp current vs. supply voltage characteristic. Figs.6,7 show the distortion in dB with the input signal as a parameter. The minimum operating voltage, which is given in these graphs as an example only, depends on the values of the load resistance and input signal. Refer to the setting of output level mentioned below.
2. Setting of Tuning-on Level
   - It is possible to use a resonant coil so that operation is available under conditions where S/N is not so good. It is also possible to use a resistor in low-cost sets.
   - The lamp turning-on level depends on the value of resistor connected to pin 4, pin 3, or the design of the resonant coil.

Fig 1. I_{CC},Pd - V_{CC}

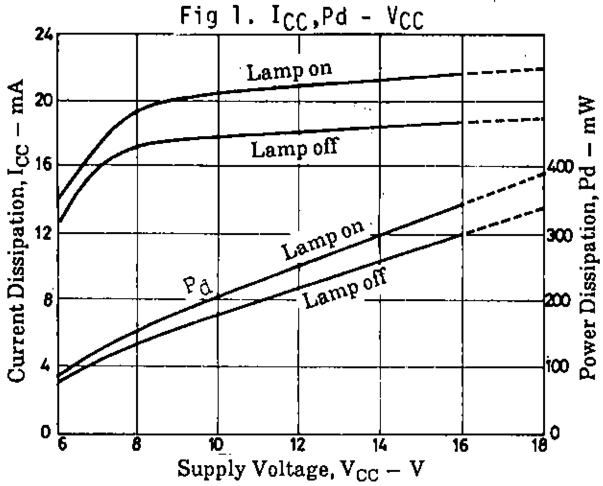


Fig 2. V_7,P_d - I_L

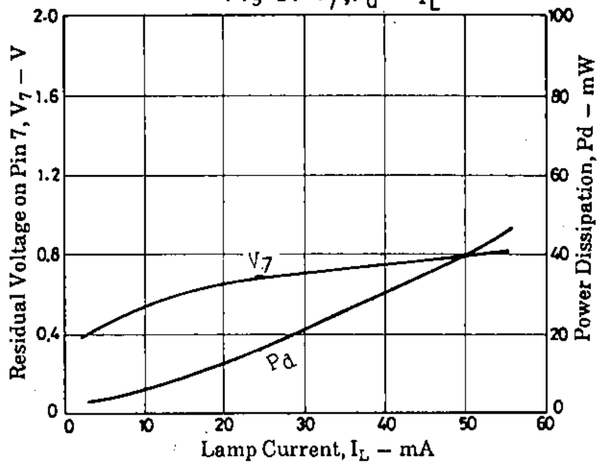


Fig 3. f_{57kHz} - V_{CC}

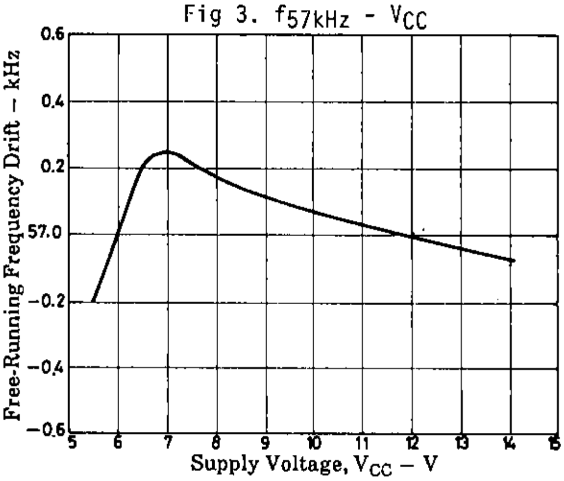


Fig 4. OUTPUT LEVEL - V_{CC}

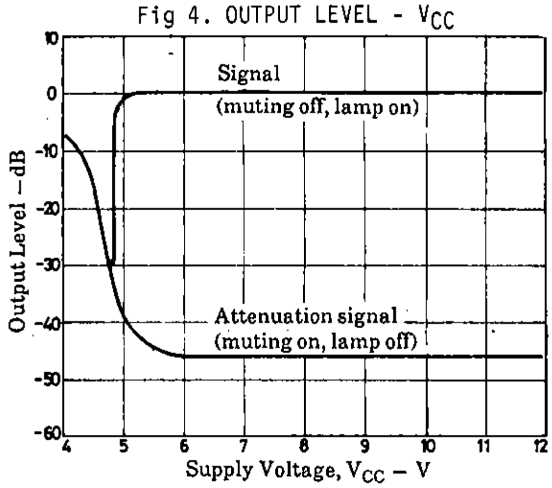


Fig 5. I_L - V_{CC}

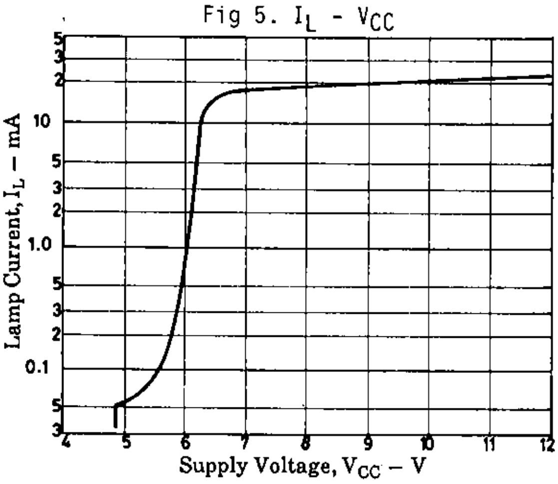


Fig 6. THD - V_{CC}

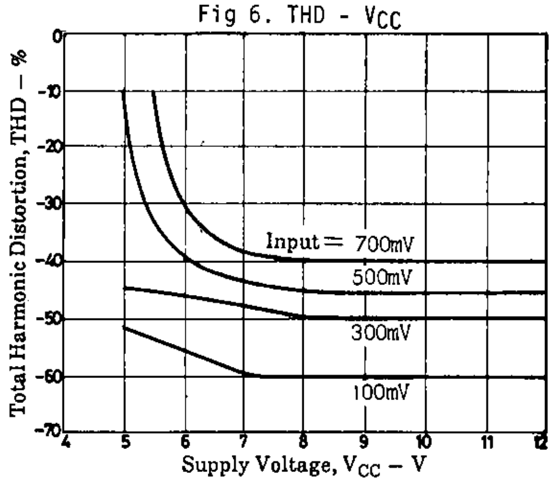
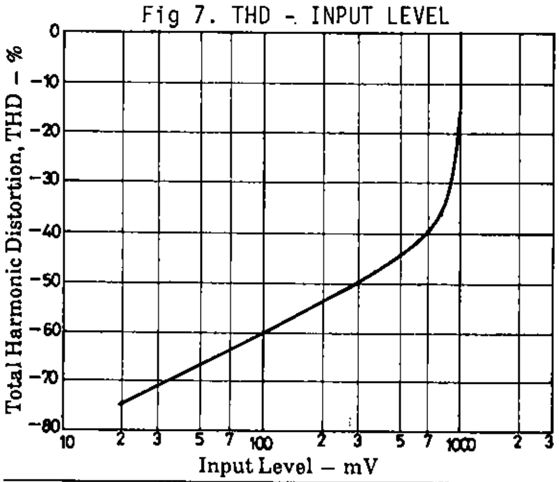


Fig 7. THD - INPUT LEVEL



Turning-on level is roughly given by the following formula :

$$V_i(57) = 21 \times n \times \frac{R_E}{\frac{Q_O}{\omega c} /\!/ R_i\ n^2}$$

where $V_i(57)$: Level at 57kHz (rms)

R_E : Impedance between pin 4 and ground (kΩ)

R_i : 5kΩ (input impedance at pin 13)

n : Turn ratio of coil

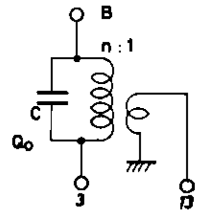
Qo : Unloaded Q

C : Resonant capacity

ω : $=2\pi f$, f=57kHz

// : Parallel calculation

Fig 8



Example : When Qo=50, C=2200pF, n=3, R_E=1kΩ

$$V_i(57) = 21 \times 3 \times \frac{1}{65/\!/45} \doteqdot 2.4\text{mV}$$

When the pin 3 resistive load is used, this formula is also used in the same way.

3. Setting of Output Level

AF output at Pin 6

- AF output gain becomes 0dB typ at 3kΩ. Similarly +6dB at 6kΩ, +10dB at 9kΩ, −6dB at 1.5kΩ, −10dB at 1kΩ.
- Output level (input level) is closely related to supply voltage. This relation is in Fig.9 with V_{CC} as a parameter.
- Capacitor 220pF paralleled to load resistor at pin 6 attenuates an VCO leak of 228kHz within IC.

BK, DK Output at Pin 5

Fig.11 shows the relation between output level (input level) and supply voltage. Fig.12 shows the relation between load resistance and gain which is a ratio of 57kHz level at pin 13 to output (BK, DK) at pin 5. Overall gain (pin 2 to 5) is obtained using a gain (pin 2 to 13) and a gain (pin 13 to 5, Fig.12). Therefore, BK, DK output level is defined by 57kHz input level at pin 2. Gain (pin 2 to 5) is roughly obtained by the following formula.

$$VG_{2-5} = 20\log\left\{\frac{\frac{Q_O}{\omega c} /\!/ R_i\ n^2}{R_E} \times \frac{1}{n}\right\}$$

Example : When Qo=50, C=2200pF, n=3, R_E=1kΩ,

$$VG_{2-5} = 20\log\left\{\frac{65 /\!/ 45}{1} \times \frac{1}{3}\right\} = 18.95\text{dB}$$

Assuming 57kHz input level at pin 2 is 10mV, load resistance is 3.3kΩ,

For DK 18.95−10=8.95dB (−10dB because of 30% mod.)

For BK 18.95−4=14.95dB (−4dB because of 60% mod.)

That is, DK, BK outputs are 28mV, 56mV respectively.

4. Capture Range

Capture range and lock range are shown in Figs.13 and 14 respectively when lamp-on level is 3 mV. Parameter is C between pin 14 and 15. C of about 0.003 to 0.1μF is recommended. For other lamp-on level than 3mV, that is, for P [mV], convert the vertical line into P/3.

5. Control Voltage on Control Pin

Pin 12 has 2 functions. One is for frequency checking. For the other, when a certain voltage is applied VCO, etc. stop and the normal reception mode is entered. This control voltage is set to be a value from 4.5 to 6.0V.

Fig 9. R_{L6} - v_i

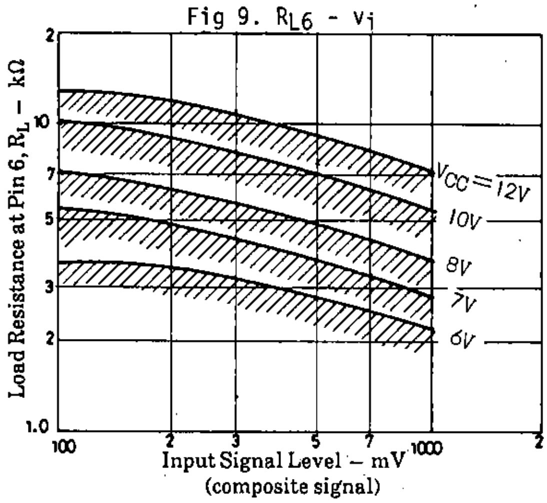


Fig 10. R_{L6} - VG_6

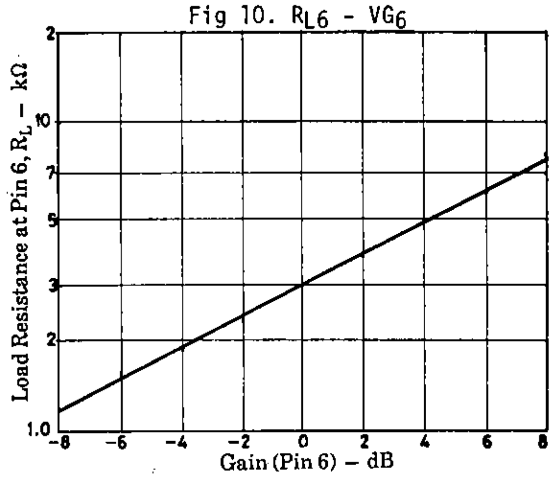


Fig 11. R_{L5} - v_i

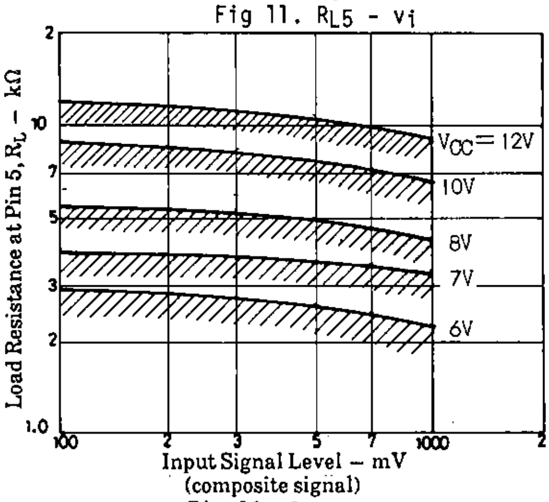


Fig 12. R_{L5} - VG_5

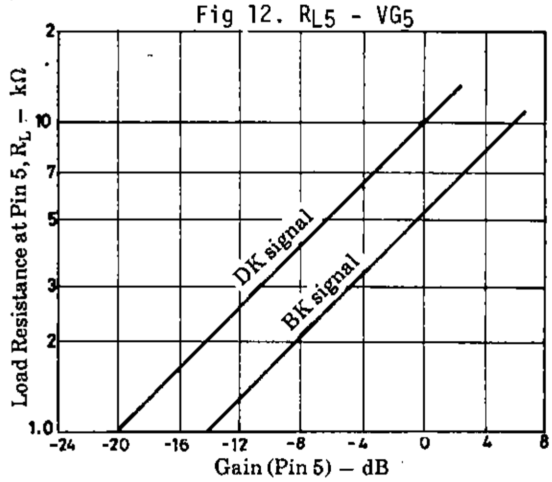


Fig 13. Capture Range

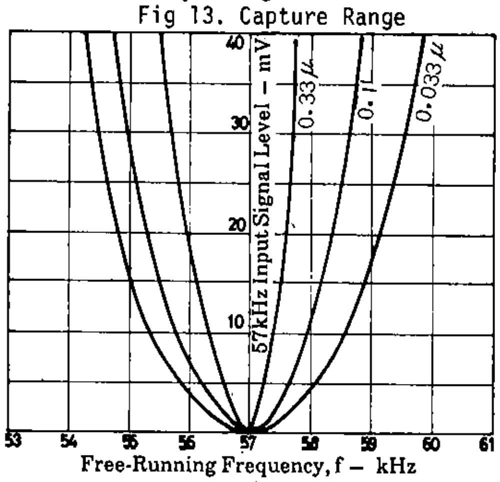


Fig 14. Lock Range

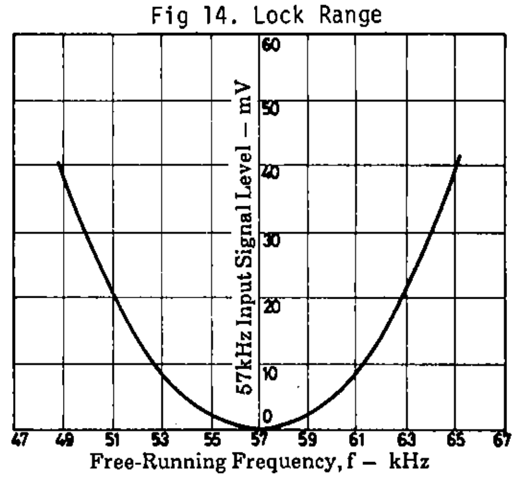


Fig 15.

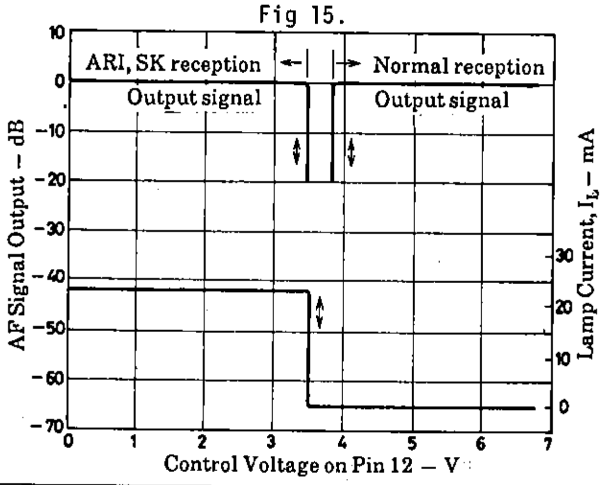
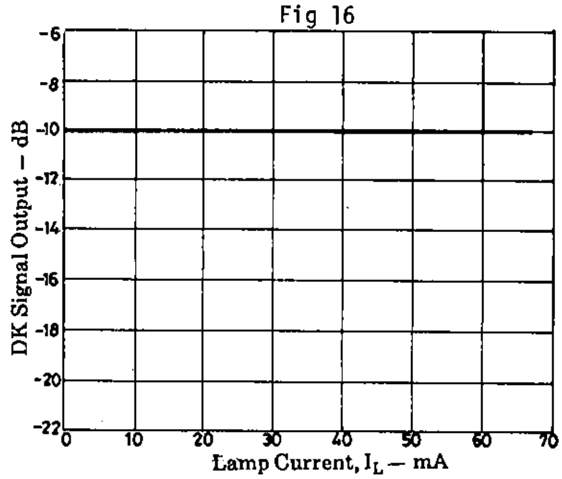


Fig 16



6. Signal Interference

Output pin of open collector type causes signal interference to occur depending on the way or value of decoupling.

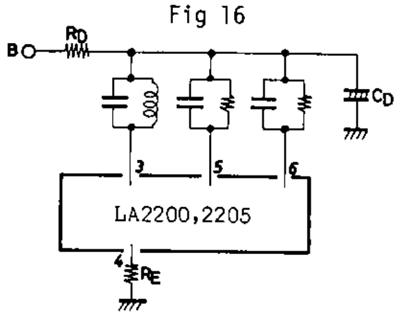
6-1 Interference of output at pin 3 to pins 5,6

This phenomenon occurs when decoupling is provided for pins 3,5, and 6 simultaneously. Interference (attenuation) level in dB is defined as :

$$AFL_{\substack{3-5\\3-6}} = 20\log\left\{\frac{R_D \;//\; \frac{1}{2\pi f_{AF} C_D}}{R_E}\right\}$$

6-2 Interference (attenuation) level in dB of output pin 5 to 6

Fig 16



$$AFL_{5-6} = 20\log\left\{\frac{R_D \;//\; \frac{1}{2\pi f_{BK/DK} C}}{2K}\right\}$$

Interference level of output pin 6 to 5 is :

$$AFL_{6-5} = 20\log\left\{\frac{R_D \;//\; \frac{1}{2\pi f_{AF} C}}{3K}\right\}$$

Each signal's attenuation in dB is given as mentioned above. To prevent actual interference, it must be considered that levels of AF signal and BK, DK signal differ extremely. Too much interference causes undesirable phenomena to occur as shown below.

$AFL_{3\text{-}6}$: Less muting attenuation at low frequencies
$AFL_{5\text{-}6}$: BK, DK signal sounds through a speaker.
$AFL_{3\text{-}5}$: Misoperation in BK, DK system may occur when AF signal contains the same
$AFL_{6\text{-}5}$ frequency as BK, DK signal.

To avoid these interferences, the following measures are recommended.

Fig 17

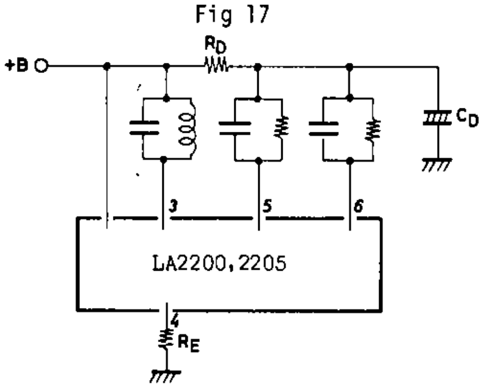
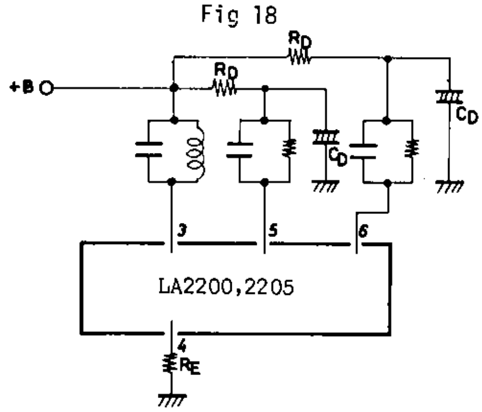


Fig 18

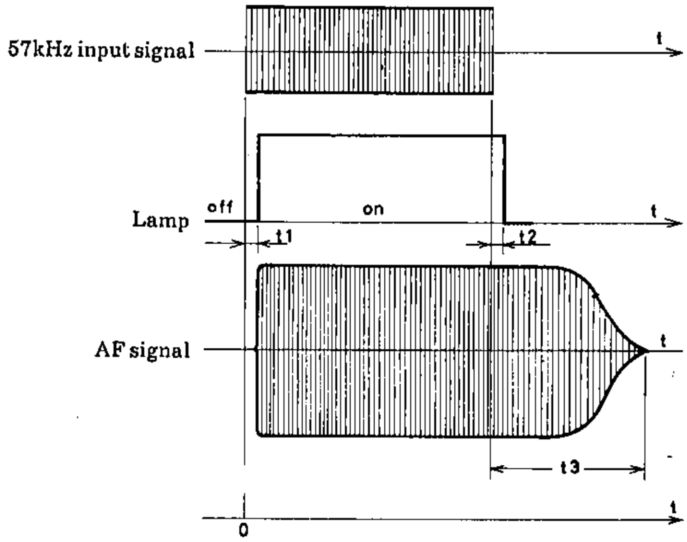


The constants in the Application Circuit are fixed with the above-mentioned considered.

7. Fade-in and Fade-out Time of AF Signal

The LA2200, 2205 provide the muting function for selecting SK station only to facilitate tuning to SK station. Signal appears fast and disappear slowly for easiness of tuning and car stereo use, which is shown in Fig.19. t_1, t_3 are taken as fade-in time (attack time), fade-out time, respectively. t_1 depends mainly on the capacitor across pins 10 and 11. Increasing the capacitor value makes t_1 longer. t_2 depends on the capacitor across pin 9 and GND. Increasing the capacitor value makes t_3 longer. t_1 and t_3 can be varied almost independently. The capacitor across pin 9 and GND is also effective against malfunction which may occur at the weak signal mode. If the 57kHz signal is affected considerably by noise at the weak signal mode and output signal appears or disappears very frequently, the value of the capacitor across pin 9 and GND should be made a little larger.

Fig 19



8. 57kHz Resonant Coil Specification

Kohrin Giken No.17-1114-01 (trial number)

Center frequency	57kHz
Resonant capacitor	2200pF
Qo	53±15%
Number of turns 1-3	300 1/2
4-6	120 1/2

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